Genomic and developmental origins of tardigrade legs

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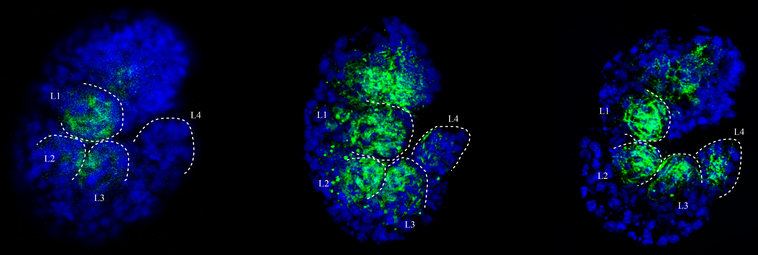
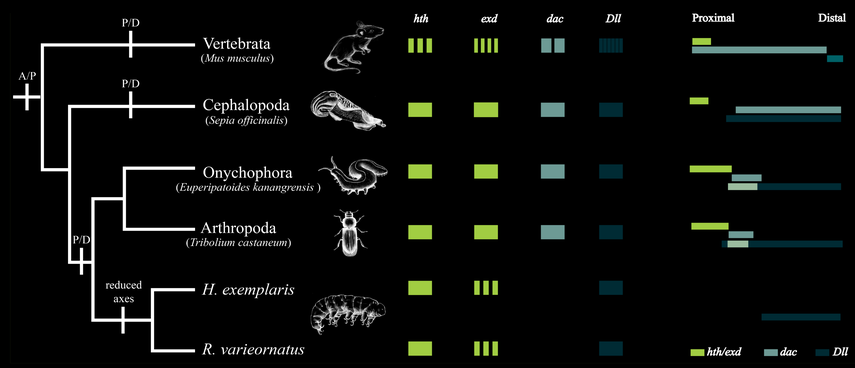
Introduction: Tardigrades lost proximal and intermediate leg domains.



hth *exd3* *Dll*



A regulatory network was co-opted independently for the evolution of appendages (P/D) from a role in nervous system patterning (A/P).

Tardigrades have lost a *dac* ortholog.

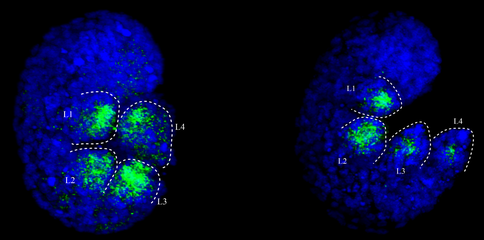
The tardigrade legs retain only distal identity.

Part 1: What candidate distal patterning genes are in tardigrades?

Table 1	*H. exemplaris*	*R. varieornatus*	*B. pennaki*
al	+	+	?
apt	+	+	?
BarH1	+	+	+
cll	+	+	+
dpp	+	+	+
Lim1	+	+	?
nub	+	+	?
rn	+	+	+
ss	+	+	?
zfh2	+	+	+

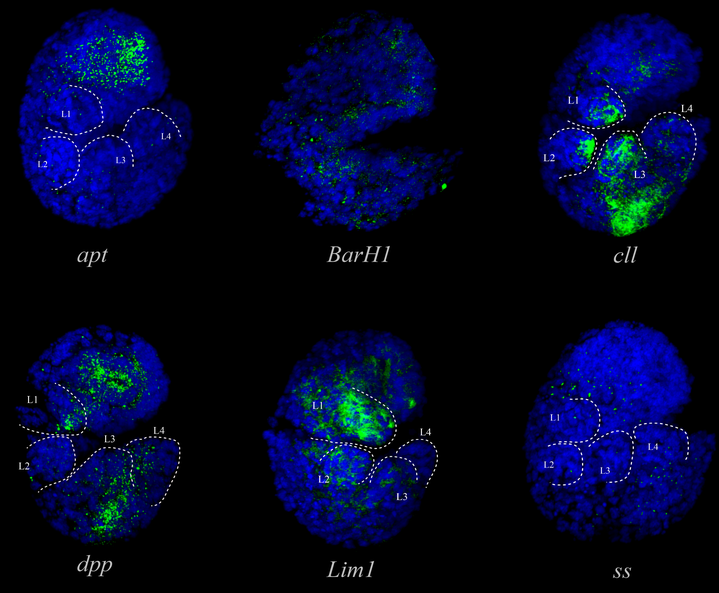
Coverage = 108x Total length = 266 Mb N50 = 1586

Part II: Where are candidate distal appendage patterning genes expressed?



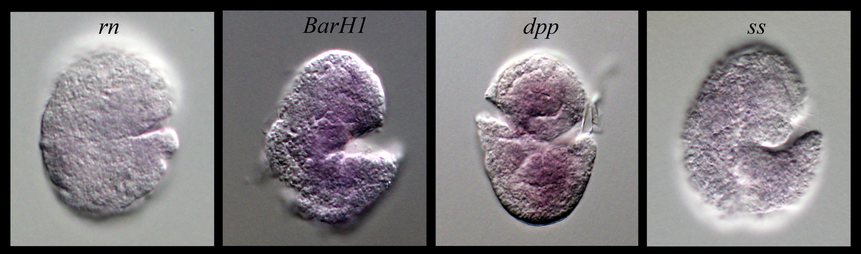
al 35hpl

al 45hpl



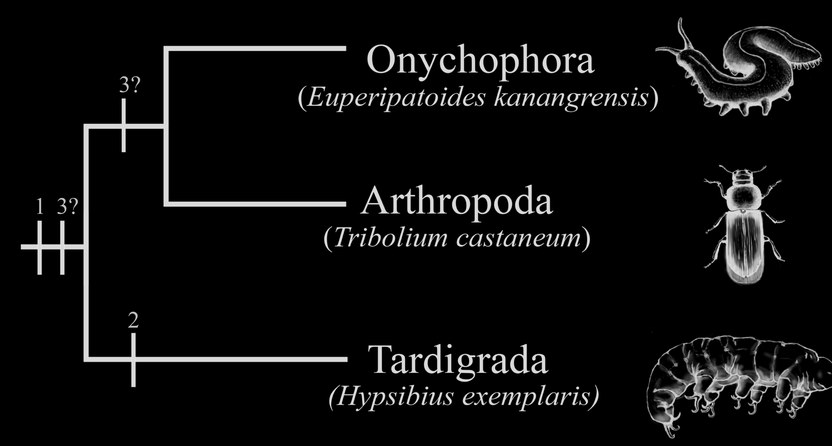
apt *BarH1* *cll*

dpp *Lim1* *ss*



Confocal images and brightfield images of leg patterning genes using *in situ* hybridization. Anterior is toward the top. All embryos are mounted laterally, facing right, and developed to 45 hours post laying (hpl), unless otherwise specified. Dashed lines trace leg buds (L1–L4).

Part III: Where did distal appendage patterning genes evolve their roles?



1. Recruitment of *al, apt, BarH1,* and *dpp* as part of the co-option of an A/P nervous system patterning network to appendage development.
2. Loss of leg patterning roles of *apt, BarH1,* and *dpp*.
3. Other genes studied may have evolved their leg patterning roles after they split from Tardigrada, or are ancestral to Panarthropoda, but lost in Tardigrada.

Conclusions

Part I: Candidate distal appendage patterning genes are conserved in tardigrade genomes.

Part II: Expression of *al* supports distal identity of tardigrade legs. Other genes studied are not expressed in one or more legs during development.

Part III: Tardigrades possess a secondarily simplified leg patterning network. Some genes may have been recruited to leg patterning in the arthropod/onychophoran lineage after it split from Tardigrada.